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The flora of Jordan: A Taxonomical revision of Juncaceae

La Flora de Jordania: Revisión Taxonómica de Juncaceae

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Abstract

A checklist, key and distribution localities were prepared for the Juncaceae family after research into the Jordanian flora was completed. According to the checklist, the Juncaceae family in Jordan includes one genus (*Juncus*) and 14 taxa (species, subspecies and varieties). During research in 2006 and 2008, two new taxa were discovered in the Jordan flora: *Juncus capitatus* Weigel in Azraq salt marshes and wet locations along the south eastern region of Jordan and *Juncus sphaerocarpus* Nees in Funck at Jordan valley near to Dead sea region.

Key words: Flora, Jordan, Juncaceae

Resumen

Se presenta una lista de las localidades, distribución y claves taxonómicas para la familia Juncaceae como resultado de una investigación completa de la flora de Jordania. De acuerdo con la lista de verificación, la familia Juncaceae en Jordania incluye un género (*Juncus*) y 14 taxones (especies, subespecies y variedades). Durante la investigación realizada entre el 2006 y 2008, dos nuevos taxones fueron descubiertos para la flora Jordania: *Juncus capitatus* Weigel en las marismas de Azraq y en los humedales a lo largo de la región sur oriental del Jordán y *Juncus sphaerocarpus* Nees en Funck en el valle del Jordán, cerca de la región del mar Muerto.

Palabras clave: Flora, Jordán, Juncaceae

Introduction

Juncaceae are mostly perennial herbs, tufted or rhizomatous. Inflorescence mainly terminal with simple or compound. Flowers are small, hermaphrodite, actiomorphic, 3-merous, wind pollinated and mostly protogynous. Perianth with 6- segments. This family is represented in Jordan by one genus (*Juncus* L.). Research into the Jordan flora has been investigated and under way since 1966 (Al-Eisawi, 1982; Bernhardt, 1993-2002; Bernhardt & Britvec, 2004; Boulos, 1977; Boulos & El-Eisawi 1978; Boulos & Lehham, 1979; Karim & Al-Qura'n, 1986-1988; Plazibat, 2000; Starmhler, 1998; Stickel *et al.* ,2000; Zohary, 1973; Zohary & Feinbrun-Dothan, 1962-1686). The aim of this study is to formulate a general checklist, keys and distribution localities for plant families were drafted as a result botanical surveys.

Materials and methods

Our research into the Juncaceae family in Jordan included work in the field as well as the analysis of herbarium specimens. Field research was carried out of between 2006–2008. Following the rationale of the project work, the target area included is the salt marshes, ditches, bogs, wetland and swamps distributed in different parts of Jordan from northern parts to the southern ones, and from eastern to the western. Six main localities were surveyed and investigated:

(1) Azraq. (2) Salt marshes of Jordan Valley and Dead Sea.(3) Northern springs. (4) Southern springs. (5) Desert Oases in Jafer and Bayer.(6) Aqaba region. Systematic research, for the most part, was done according to collection of represented samples from the investigates localities to be identified according to the checklist prepared by Al-Eisawi (1982) and Flora Palaestina (1962-1986). In order to determine the distribution of Juncaceae, materials from different herbaria (Jordan University, Yarmouk University, Agricultural center of development at Ministry of Agriculture in Jordan) were used along with our other recent specimen collections of the research area.

Results and discussion

The Juncaceae family within the Flora of Jordan was represented by one genus (*Juncus*) and 16 plant taxa (Table 1). According to the checklist, the *Juncus* is represented by the 16 taxa (12 species, 2 subspecies and 2 varieties). Within the Flora of Jordan, two *Juncus* species *Juncus capitatus* Weigel in Azraq salt marshes and wet locations along the south eastern region of Jordan and *Juncus sphaerocarpus* Nees in Funck at Jordan valley near to Dead Sea region were new recorded and added to the botanical taxa of Jordan flora (see Table 1).

Table 1 Checklist of Juncaceae taxa in Jordan with species, subspecies and varieties

No.	Species, subspecies and varieties	Geographical distribution
1.	*Juncus acutus* L.	(1) + (4) + (6)
2.	*J. acutus* L.subsp. *acutus* Aschers & Graebn	(2) + (3)
3.	*J. acutus* subsp. *littoralis* (C.A.Mey.)Feibr.	(4) + (6)
4.	*J. articulatus* L.	(5) + (6)
5.	*J. bufonius* L.	(1) + (3) + (4)
6.	*J. bufonius* L. Var. *bufonius* Wahlberg	(2) + (6)
7.	*J. bufonius* L. Var. *congestus* Wahlberg	(3) + (4) + (5)
8.	*J. capitatus* Weigel	(1) + (2) + (5)
9.	*J. effusus* L.	(2) + (3) + (4)
10.	*J. fontanesii* J. Gay	(1) + (4) + (6)
11.	*J. inflexus* L.	(3) + (4) + (6)
12.	*J. maritimus* Lam.	(4) + (5)
13.	*J. punctorius* L. fil.	(3) + (4) + (6)
14.	*J. rigidus* Desf.	(1) + (4) + (6)
15.	*J. sphaerocarpus* Nees in Funck	(2) + (4) + (5)
16.	*J. subulatus* Forssk.	(1) + (3) + (4)

It is very difficult sometimes to differentiate among the taxa; for example, *J. fontanesii* J. Gay is different than the species *J. inflexus* L. by the length of the perianth. However, some species may be clearly differentiated in our area not only by morphological parameters, but also by ecological and phenological aspects (*J. fontanesii* J. Gay blooms later than *J. inflexus* L and inhabits dryer habitats).

The *Juncus bufonius* complex in general, as is the case in Jordan, has been insufficiently studied to date, because the species are very similar and systematically are closely related, showing a high degree of phenotypical plasticity as remarked by *Juncus* L. studied, Hence, further taxonomic and experimental studies are necessary as well as molecular investigations. Generally, the plasticity of *Juncus* is very high. In *J. articulatus* L. the water level dynamics and soil nutrients introduce plasticity in morphological parameters and strategy type (Zohary, 1973). However, more research is needed prior to any final decisions.

Determination key

To identify the plant taxa within the family Juncaceae in Jordan, we offer the following adjusted determination key.

JUNCACEAE Juss.

Juncus L.

1. Annual plant 2

1' Perennial plant 6

2. Flowers solitary 3

2' Flowers aggregated in dense of 2–20; seeds 0.3–0.5mm in length. Annual plant, 5–20 cm in height. *J. capitatus*

3. Leaf sheaths with auricules; inner perianth segments brown with central stripe, leathery at edges, equal in length to capsule; flowers in loosely branched cymose inflorescence. Annual herb, 5–30 cm in height. *J. sphaerocarpus*

3' Leaf sheaths without auricles; perianth segments greenish 4

4. Capsule 3–5mmin length; with 6 anthers, anthers at least 2/5 of the length of the filaments. Annual herb, 10–25 (–40) cm in height. *J. bufonius*

4' Capsule 2.5–3.0 mm in length; 3 anthers, anthers at least 1/4– /3 length of filaments. Annual herb, 1–5 (–10) cm in height. *J. arabica*

5. Leaves and bracts filamentous or ± cylindrical or sharply-pointed, typical for *Juncus*-Species 6

5' Leaves otherwise, not situated only at the base or on lower part of plant, but also in the upper parts of the plant or with long terminal bract 12

6. Leaves and bracts sharply-pointed or at least hardy, more than 3mmin diameter 7

6' Leaves and bracts not pointed or hardy, less than 3mmin diameter (important: bracts of *J. inflexus* may be hardy and slightly pointed,but they are thin. 9

7. Perianth segments yellowish-green; capsule of equal length to perianth segments. Perennial plant, 50–100 (–120) cm in height. *J. maritumus*

7' Perianth segments brown to reddish-brown; capsule substantially longer than perianth Segments 8

8. Capsule 4 × 6 mm; 80–120 seeds. Perennial plant, 50–150 cm in height. *J.acutusssp.acutus*

8' Capsule 2 × 4 mm; 25–70 seeds. Perennial plant, 50–150 cm in height. *J. subulatus*

9. Stems with cross partitioned cortex, grey or blue-green colour, leaf sheaths blackish-brown to blackish-red. 10

9' Stems with not cross partitioned cortex, leaf sheaths yellowish to reddish-brown 11

10. Capsule same length as perianth segments; plant blue-green colour. – Perennial plant, 30–60 cm in height. *J. inflexus*

10' Capsule 1.5–2 times longer than perianth segments; plant greenish colour Perennial plant, 50–120 cm in height. *J. fontanesii*

11. Stem and leaves shiny dark green colour, smooth, bract appearing as stemat base of inflorescence (virtually) without enlargement; inflorescence mostly ± loose; 6 anthers. Perennial plants, 30–150 cm in height. *J. effusus*

11' Stems and leaves green, not shiny, with 12–13 lengthwise grooves; bract appearing as stem, slightlyenlarged at base of inflorescence; inflorescence very compact, ball-like in appearance; usually with 3 anthers. Perennial plant, (20–) 40–100 cm in height. *J. articulatus*

12. All flowers compacted into 1 (–3) heads; outer perianth segments much longer than inner perianth segments. Annual herb, 3–10 (–15) cm in height. *J. capitatus*

12' Flowers ± solitary, in several groups or mostly in 1–3 heads; all perianth segments ± equal length 13

13. Stem leafless or with only one basal leaf, but with bract directly underneath terminal inflorescence;leaves 1–2 mm thick; perianth segments sharply-pointed. Perennial plant, 15–40 cmin height. *J. rigidus*

13' Stem with one leaf above base (not including bracts directly underneath inflorescences!); leaves 0.5–3.0 mm thick 14

14. Flowers ± solitary (sometimes the highest flowers somewhat approached), each with 2 small bracteoles at base; leaves 1–2mm wide; perianth segments ± rounded 15

14' Flowers in groups; stems thicker than 1 mm; most leaves >1 mm in width, not very hardy; plant generallytaller than 30 cm, grasslike in appearance 16

15. Perianth segments 2–3 mm, almost half the length of the capsule. Perennial plant, 15–30 cmin height. *J. punctorius*

15' Perianth segments 4 mm in length, equal in length to capsule. Perennial plant, 15–50 cm in heigh. 18

16. Leaves lengthwise and transverse septa. The septa filled with spider-like cortex, all perianth segments blunt. Perennial plant, 50–120 cm in height. *J. subulatus*

16' Leaves only transverse septa. The septa filled with spider-like cortex or completely hollow; all perianth segments sharply-pointed 17

17. Internal leaf septa completely hollow (without spider-like cortex); stem erect; capsule brown, gradually lengthwise tapered; longer than perianth segments; plant reproduces by rhizomes. *J. acutus* L. subssp. *littoralis*

17' Internal leaf septa at least with solitary spider-like cortex or complete spider-like cortex; stem erect or ascending; capsule short tapered or egg-shaped 18

18. Leaves 5–7 – angled in cross-section, when fresh show exceptionally pronounced lengthwise stripes; capsule with clearly visible, long, frequently slanted beak, equal in length to perianth segments; perianth segments sharply-pointed. *J.effusus*

18' Leaves round or elliptical in cross-section, without lengthwise stripes; capsule with short, spiky tip, longer than perianth segments; all perianth segments equal in length, inner perianth segments blunt. Perennial, 10–60 cm in height. *J. articulatus*

Distribution

During research in 2006 and 2008, two new taxa were established in the flora of Jordan: *Juncus capitatus* Weigel in Azraq salt marshes and wet locations along the south eastern region of Jordan and *Juncus sphaerocarpus* Nees in Funck at Jordan valley near to Dead sea region.

We also established the presence of the following taxa: *Juncus acutus* L., *J. acutus* L.subsp. *acutus* Aschers & Graebn, *J. acutus* L. subsp. *littoralis* (C.A.Mey.)Feibr, *J. articulatus* L., *J. bufonius* L., *J. bufonius* L. Var. *bufonius* Wahlberg, *J. bufonius* L. Var. *congestus* Wahlberg, *J. effusus* L., *J. fontanesii* J. Gay, *J. inflexus* L., *J. maritimus* Lam., *J. punctorius* L. fil, *J. rigidus* Desf. and *J. subulatus* Forssk. *Juncus* L. was found at the wet border of pools inside of sheep grazing meadows. Grazing seems to be an important factor to promote open spaces that can be colonized by the *Juncus* species. The most widely distributed taxa in the coastal regions of Aqaba and Dead sea in Jordan rift valley, in highly saline locations, are *J. maritimus* and *J. acutus* ssp. *acutus*, which also appears in non-saline environments, while the species *J. inflexus* and *J. articulatus* are also widely distributed in the interior of Jordan at northern and southern springs. On typical saline marshes, such as at the Jordan valley and dead sea region, we frequently find *J. rigidus* Desf. To complete studies about the distribution and variation of species from the Juncaceae family, further research is necessary. Presumably, the presentation of a determination key indicates pending activities of collection and to mapping of *Juncus* taxa.

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